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Efficacy of Gibberellic Acid and Sulphur onnutrient content, uptake and sulphur use efficiencyby Mustard *(Brassica juncea* L.) under Aravalli hills of Rajasthan

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Abstract

A field experiment entitled **"Efficacy of Gibberellic Acid and Sulphur onnutrient content, uptake and sulphur use efficiencyby Mustard *(Brassica juncea* L.) underAravalli hills of Rajasthan"** was conducted during *rabi* season of 2020-21 at the research farm of Rajasthan College of Agriculture, Udaipur.The experiment consisting of four levels (control, 20, 40 and 60 kg ha^{-1}) of sulphur and four levels (control, 25, 50 and 75 ppm) of gibberellic acid there by making 16 treatment combinations, were laid out in Factorial Randomized Block Design and replicated three times. The significant increase in nutrient content and nutrient uptake *viz.,* N, P, K and S in seed and stover was observed with 40 kg S ha^{-1} ad 50 ppm GA_3.The sulphur accumulation and sulphur use efficiency was found maximum at foliar spray of 50ppm $GA_3$when basal dose of sulphur is applied.

1. Introduction

Oilseed crops are next to cereals in production of agricultural commodities in India, and they play a vital role in the Indian economy. Rapeseed-mustard is the second most important edible oilseed after groundnut, with a total area of 6.23 m ha and an output of 9.34 mt (Anonymous, 2019).The unbalanced use of fertilizers is the main cause for low productivity of mustard.Sulphur is an essential component in determining seed yield, oil content, quality and resistance to various biotic and abiotic stresses. Compared to other crops mustard is more responsive to sulphur. Brassica family requires more sulphur than any other field crops.Several

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studies confirmed that nitrogen utilization is improved when the availability of sulphur increased and thus photosynthesis, growth, dry mass accumulation of crop is also improved (Tandon, 1995; Koprivaet *al.*, 2002).Sulphur levels has beneficial effect on sulphur uptake, stover and seed yield (Sharma *et al.*, 2009).

The main limitations to attain maximum seed yield of mustard are lodging, shattering of fruits and indeterminate plant growth. The poor hormonal imbalance and weakly developed lignified cell wall is responsible for the loss of seed yield due to shattering of fruits. Incorporated use of balanced nutrients and PGRs significantly increase the yield and quality of grains through coordinating various physiological process like specific stimulation of fruits and source to sink relation (Rathke*etal.*, 2006).Gibberellins are a group of tetracyclic diterpenoids which promote plant growth and development.It is reported earlier that gibberellic acid and nitrogen help in achieving the desired level of food production (Nasiruddin and Roy, 2011). Studies revealed that gibberellic acid has the capability to improve growth, flowering, photosynthesis, nutrient transport and yield of mustard (Hayat *et al*., 2001; Khan *et al*., 2005).

2. Materials and Methods

The experiment was conducted during *rabi* season of 2020-21 at the research farm of Rajasthan College of Agriculture, Udaipur.The experimental site is situated at South–Eastern part of Rajasthan at 24˚34' N latitude and 73˚42' E longitude at an altitude of 582.17 m above mean sea level. The region falls under the agro-climatic zone Ⅳ-a of Rajasthan.The maximum and minimum temperature ranged between 32.3˚C and 4.1˚C. Mean weekly maximum and minimum relative humidity ranged between 90.6% and 22.7% respectively and the total rainfall received during the crop period is 12.6 mm.The soil analysis confirmed that soil of experimental field was clay loam belongs to Typic*Haplustepts*, neutral alkaline in reaction, medium in available nitrogen and phosphorus and high in available potassium and low insulphur.

The experiment consisting of four levels (control, 20, 40 and 60 kg ha^{-1}) of sulphur and four levels (control, 25, 50 and 75 ppm) of gibberellic acid there by making 16 treatment combinations, were laid out in Factorial Randomized Block Design and replicated three times.The seed was sown manually on 23 October 2020 by placing 2 seeds at a depth of 3–4

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cm.Thinning was done after 25-30 days after sowing maintaining row to row and plant to plant distance 30 x 10 cm. Inorder to minimise weed competition, a hand weeding was done on the same day of thinning.Three irrigations were given to mustard crop. First irrigation was given after sowing, second irrigation was done at 20-25 days after sowing and third irrigation was given at pod filling stage of the crop. Recommended dose of NP *viz.*, 60 kg N, 40 kg P_2O_5 was applied uniformly through urea and DAP respectively.Half dose of nitrogen and full dose of phosphorous was applied as basal dressing at the time of sowing and remaining half dose of nitrogen was top dressed after second irrigation.

3. Results and Discussion

3.1 Effect of sulphur

Nutrient content and uptake

Nutrient contentand uptake *viz.*, N, P, K and S in seed and stover were improved upto the fertility level of 40 kg S ha^{-1}. Application of sulphur lowers the soil pH and increase the availability of nutrient content in soil. The involvement of sulphur in many metabolic pathways helps the crop in growth and development and improves the availability of nutrients through better root development and translocates these nutrients into various plant parts (Mishra 2001). The yield and nutrient content influence the uptake of nutrients and the present findings indicate that application of sulphur significantly enhanced the uptake of N, P and K over control. This positive effect of applied sulphur on the nutrient uptake might be due to the higher seed and stover yield together with higher nutrient content under optimum sulphur concentration. The sulphur content and uptake significantly increased due to the increased concentration of sulphur in soil solution with the application of 40kg S ha^{-1}. This might have resulted in profused root and vegetative growth and enhance the absorption of nutrients from soil. The lowering of soil pH by sulphur application increase the availability of native N, P and K and extraction and translocation of these nutrients marks the improved nutritional status of the plant. Jat and Mehra (2007) also reported that the absorption of nutrients mainly depend upon their available form and other physical properties of the soil. The finding also add that the conductive property of sulphate concentration of soil helps to balance the uptake of other nutrients. These findings quite collaborate with Piri*et al.*, (2006) and Patel *et al.*, (2009).

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3.2 Effect of gibberellic acid

The maximumnutrient content and nutrient uptake *viz.*, N, P, K and S in seed and stover was recorded with the foliar application of 50 ppm GA_3.This uptake was mainly during the building of structural organs. The improvement in soil structure and availability of nutrients on the rhizosphere increases the uptake of nutrients. As earlier mentioned the foliar application of GA_3 enhances the leaf area and crop canopies, these puts an extensive pressure on the roots of the crop to extract the available nutrients. Baker (1985) reported that GA_3promote the phloem loading in the crop. Thus the efficient partioning of the assimilate into more demanding sinks under the influence of gibberellic acid has increased the nutrient content in the grain and the stover. The reports show that GA_3 receiving plants show increased sulphur and nitrogen use efficiency as both of their assimilatory pathways are well coordinated. So increase in one component increases the other. Similar findings have also been reported by Khan*et al.*, (2002) and Nagel and Lambers (2002).

3.3 Sulphur use efficiency (SUE)

This parameter was calculated by dividing the per cent increase in yield by percentage increase in sulphur uptake. The sulphur use efficiency was found maximum only when the optimum amount of fertilizer applied. Foliar application of gibberellic acid improved the sulphur use efficiency than control. Similar findings have been reported by Khan *et al.*, (2002).

Table 5.1: Sulphur use efficiency (SUE)

Amount of sulphur applied (kg/ha)	Sulphur use efficiency (%) due to 50ppm GA_3
20	30.3
40	36.5
60	31.23

4. Conclusion

On the basis of present study conducted during *rabi*2020-2021, it can be concluded that there was significant response for application of sulphur and gibberellic acid on mustard crop.Mustard

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Treatments	Nitrogen content (%)	Phosphorous content (%)	Potassium content (%)	Sulphur content (%)

variety Giriraj should receive a sulphur dose of 40 kg S ha^{-1} and GA3@ 50ppm under the agroclimatic condition prevalent at Udaipur for obtaining higher growth and yield. The sulphur accumulation and sulphur use efficiency was found maximum at foliar spray of 50ppm GA3 when basal dose of sulphur is applied.

Table 3.1: Effect of sulphur and gibberellic acid on nutrient content of mustard

Table 3.2: Effect of sulphur and gibberellic acid on nutrient uptake by mustard

Treatments	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover
	Nitrogen uptake(kg ha^{-1})				**Phosphorous uptake(kg ha^{-1})**			**Sulphur uptake (kg ha^{-1})**
Sulphur								
Control	2.17	0.61	0.61	0.17	0.61	1.28	0.62	0.43
20 kg S ha^{-1}	2.46	0.67	0.64	0.19	0.68	1.37	0.64	0.47
40 kg S ha^{-1}	2.67	0.74	0.70	0.23	0.80	1.50	0.69	0.52
60 Kg S ha^{-1}	2.52	0.71	0.66	0.22	0.75	1.43	0.67	0.50
S.Em.±	0.02	0.01	0.01	0.005	0.01	0.01	0.003	0.005
C.D. (P = 0.05)	0.06	0.02	0.04	0.01	0.03	0.04	0.02	0.02
Gibberellic acid								
Control	1.85	0.58	0.56	0.16	0.54	1.21	0.58	0.41
25 ppm GA_3	2.61	0.70	0.67	0.21	0.74	1.43	0.67	0.49
50 ppm GA_3	2.88	0.74	0.71	0.22	0.81	1.52	0.70	0.53
75ppm GA_3	2. 66	0.72	0.69	0.22	0.77	1.46	0.68	0.50
S.Em.±	0.02	0.01	0.01	0.005	0.01	0.01	0.003	0.005
C.D. (P = 0.05)	0.06	0.02	0.04	0.01	0.03	0.04	0.02	0.02

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	Potassium uptake(kg ha^{-1})							
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
Sulphur								
Control	27.45	19	7.62	5.44	7. 66	39.71	7.73	13.26
20 kg S ha^{-1}	33.93	24.6	8.80	6.89	9.37	50.1	8.81	17.09
40 kg S ha^{-1}	39.78	30.44	10.49	9.35	11.49	61.55	10.38	21.39
60 Kg S ha^{-1}				8.				
	38.77	28.2	9.57	67	11.4	60.11	9.67	19.76
S.Em.±	0.29	0.302	0.19	0.14	0.18	0.53	0.05	0.25
C.D. (P = 0.05)	0.85	0.84	0.55	0.4	0.52	1.53	0.14	0.73
Gibberellic acid								
Control	21.54	16.44	6.51	4.47	6.28	34.61	6.75	11.69
25 ppm GA_3	38.23	27.21	9.59	8.25	10.67	55.13	9.58	18.87
50 ppm GA_3	43.2	31.80	10.72	9.98	12			
						61.85	10.51	22.27
75ppm GA_3	40.8	29.54	10.12	8.92		59.89		
					11.8		10.01	20.44
S.Em.±	0.29	0.302	0.19	0.14	0.18	0.53	0.05	0.25
C.D. (P = 0.05)	0.85	0.84	0.55	0.4	0.52	1.53	0.14	0.73

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